DETERMINATION OF HARDNESS POLYPROPYLENE FLAME RETARDANTS REOGARD 2000® USING SHORE D METHODE

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Abstract: *Researches on the influence of structure and hardness of the flame retardant of polymeric materials have been made over the years to such material combination from the simple to the complex.*

It is known that in order to improve fire resistance in raw material composition introducing flame retardants. In this paper we propose to determine the behaviour of the gradual introduction of Reogard 2000® flame retardant polymer material structure - Polypropylene, causing hardness fireproof polypropylene with Reogard 2000®. The method of determination is - method Shore D. Tests was made on various samples of polypropylene with concentrations of 5%, 10%, 15%, 20%, 25% Reogard 2000®.

Keywords: *polypropylene, flame retardant, method Shore D,*

1. INTRODUCTION

Polypropylene or polypropene (PP) is a thermoplastic polymer made by the chemical industry and used in a wide variety of applications, including food packaging, ropes textiles, plastic parts and reusable containers of various types, laboratory equipment, loudspeakers, polymer banknotes and vehicle components. Polypropylene has a lower density although this is offset by a higher stiffness and hardness. It is the most rigid of polyolefin polymers and maintains this feature up to 100°C [1,2,3]. Resistance to abrasion and heat is remarkable, but must be recorded at the same time and excellent dielectric and insulating features, and extraordinary resistance to repeated folding. Polypropylene is stable polymer aggressive and it becomes soft at temperatures greater than 160-170°C [1]. A special field in which it is used polypropylene is the production of vehicle components. The sides can be made of doors, full board or board's instrument panel, seats parts, the installation audio etc. Thin strips of polypropylene are used as insulating material (dielectric) for electrical system vehicle with high performance capacitive [4]. Because PP is inflammable, the addition of a flame retardant is an essential requirement if we wish to achieve a PP based composite with good flame resistance [5].

Various flame retardancy combinations can be used to delay the burning process of organic materials. These compounds include halogenous, mineral hydroxides [6] and organophosphorus compounds.[7] magnesium silicate or calcium carbonate [8] and the nanocomposite based on montmorillonite (layered silicate) or carbon nanotubes [9] and the intumescent system [10] were studied in the literature.

Some halogen containing flame retarded PP systems may produce large amounts of smoke and toxic gas on burning. As halogen-free products, the intumescent flame retardant Reogard2000 is expected to be used and effective in PP. The Reogard2000 is free from ''milky'' water baths during extrusion and the production of ammonia odour, which can be a concern with other competitive intumescent technologies. Besides being halogen free, the intumescent flame retardant systems have the advantages of low toxicity, low corrosion and absence of melt dropping [11].

Mixtures of polymers falling within the subgroup polymers burden interest present composite materials disperse fillers and fibrous fillers composites (reinforcement) [12].

The processing of thermoplastic polymers which can be inserted fillers, the most important are: polyolefins, polyamides, polyesters, ABS polymers, polycarbonates, PVC [12].

In order to obtain good physical and mechanical properties of the thermoplastic polymer products containing fillers it is necessary to disperse as uniform distribution of broad polymer. A good adhesion of the polymer to the filler material, and the wettability of the filler by the polymer allow obtaining compositions with a high content of filler and physico-mechanical acceptable. Since the vast majority of fillers are lipophilic, they are difficult to disperse in the polymer mass, is not wetted by these, and polymer-filler adhesion is reduced. [12]

The manner in which the fillers affect the characteristics of the polymer depending on the nature of the polymer, the nature and proportion of the filler material,

conditions for obtaining and processing the mixture. [13, 14 - 17]

Starting from the last process concluded that the properties physical-mechanical properties and good processability improving materials composites can be obtained by direct introduction into the system of macromolecular compatibilizing agents [16, 17, 20].

In most cases the treatment of materials thermoplastic batches using techniques used for polymer thermoplastic construction with particular equipment used. The range which may be made of thermoplastic charge covers all areas characterized by the use of plastics non charge [16, 17, 20].

Studies have shown that in all the mixtures consisting of thermoplastic polymers and fillers, in addition to the nature and proportion of components in the system characteristics are obtained determined by [19]:

- the shape and size of the filler particles;

- the degree of distribution of the filler particles in the phase (matrix polymer);

- the adhesion of the polymer to the filler material;

- the degree of wetting of the filler material particles the polymer.

These drawbacks can be alleviated if the option surface treatment filler materials, made by:

- the chemical interaction of the fillers with compounds possessing functional groups;

- chemical absorption on the particulate material filling of modifying agents;

- coating the filler particles with an agent coupling according to.

These procedures are generally time-consuming and results in a rise of fillers, but offers the possibility of increasing significant filler content in mixtures with deterioration of their [20].

In this study we determine the hardness behaviour of polypropylene and polypropylene composites with Reogard 2000® and how Reogard2000® in hardness polypropylene act.

Mechanical characterization of composite materials is difficult because of the multiple parameters to be considered in order to express the material response to various stress conditions.

This behaviour is due to the mechanical features such as:

- existence of several mechanisms of deformation with special effects on the size and nature of deformation, due to which the same material in different conditions can behave elastic or viscoelastic;

- dependent mechanical properties of many factors: environment (temperature, humidity, chemical agents, radiation, the electromagnetic fields) attempt parameters (type of application, application directions, loading speed, variation in time of pregnancy, the duration etc.), the conditions for obtaining the material (pressure, temperature, vibration modes, fillers etc.);

- ageing material while;

-reinforcement parameters (material type, volume percentage reinforcement system arrangements of reinforcement, adhesives and additives use genuine, reinforcement technology).

The literature has not yet developed a theory to fully describe the mechanical behaviour of composites and their mechanical characteristics dependent mechanisms. There are models that describe these materials in part, in limited circumstances, be used to organize the tests, and to calculate the strength of the structures of these materials [21].

Fatigue reinforced polymer shows similar features compared to the phenomenon known metals.

Pronounced elastic properties due to large energy losses occur by hysteresis material heats and thermal conductivity is low because the temperature can stabilize at high levels, its effect is very important - the material can be destroyed by spontaneous heating.

2. Experimental part

Materials

The PP/R2000 blends containing 0, 5, 10, 15, 20 and 25 wt.-% of R2000 are designated as neat PP, 95%PP/5% R2000, 90%PP/10% R2000, 85%PP/15% R2000, 80%PP/20% R2000 and 75%PP/25% R2000 blends. The materials for the study were compression moulded at 220^{o}C.

Determination of hardness of plastics is either the penetration (method SHORE, ISO 868-95 stairway A and D), or by increasing penetration depth sensitive under the action of a task (Rockwell method).

Method SHORE A and D refer to the determination of the penetration hardness of plastics with Shore harnesses' according to ISO 868-95. For soft plastics is using SHORE A instrument, and for rigid plastics, SHORE type D instrument.

This method enables or measuring the initial penetration or penetration measurement after a set time. Penetration is expressed in conventional units specific to these devices, called degrees Shore A or Shore D grade. With Shore A, the point of the steel rod dents in the material, whereas with Shore D it penetrates into the material. The depth of indentation or penetration is measured on a scale of 0 to 100. The steel rod is either configured as a frustum cone (Shore A) or a needle pin (Shore D). Because the method is empirical is not possible to establish a simple relationship between the hardness of the core material penetration properties.

In order to determine the hardness of materials the Shore test, named after Albert F. Shore, is used. Shore is the one who suggested this test in 1907.

3. Results and discussion

The use of additives is a common way to modify polypropylene properties. Also additions of these compounds to the polymer result in increasing or decreasing the physical and mechanical properties of the polymer.[17] Furthermore recently, Samyn et al.[19] have claimed that the efficiency of intumescent flame retardant can be reached at reasonable loading (around 25 wt. %) without compromising the other properties of the matrix polymer [20].

Method of Shore D hardness is measured in plastic penetration of a penetrating tip that is shaped like a truncated cone under a force due to a spring. The test is performed in determinates conditions.

Hardness is the property of a material that expresses the degree of resistance to scratching, puncturing or deformation. Hardness of the material is determined by several methods based on measuring the footprint that a penetrator leaves on the surface. Hardness by penetration varies inversely with depth of penetration and is related to the modulus of elasticity and viscoelastic properties of the material.

Due to the shape and size of peak penetration force applied, the influence of the experimental results cannot establish a certain relationship between the results obtained with another type of durometer or other instruments to measure hardness.

The test is made with a measuring device called durometer and the Shore hardness is a number comprised between 0 and 100 defined in many standards such as ASTM D 2240:2003, BS 903:1997, ISO 7619:2004.

The determinations SHORE D hardness tests are shown in table1. For each type of specimen was made by 5 determinations.

Table 1. Determinations SHORE D

Type of material	1	2	3	4	5	SHORE D hardness
A	66°	66°	66°	67°	65°	66°
B	70°	66°	68°	64°	67°	67°
C	66°	68°	69°	68°	69°	68°
D	67°	69°	70°	68°	68°	68°
E	68°	70°	69°	69°	68°	68°

Analysing the results we can say that the incorporation of reogard lead to increased hardness of polypropylene and is observed as 15% Reogard mixed with polypropylene hardness remains constant.

In conclusion, the optimal amount of Reogard2000® incorporated into the composite is 15%.

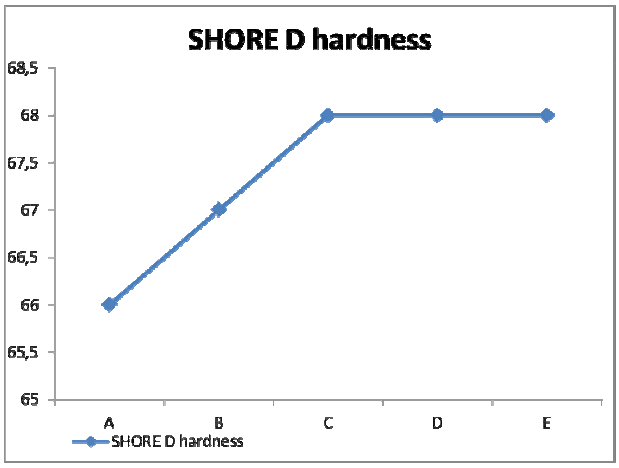

Figure 1. Determining hardness polypropylene depending on the concentration of Reogard.

Legend:
The specimen A is PP+5%Reogard2000®,
The specimen B is PP+10% Reogard2000®,
The specimen C is PP +15% Reogard2000®,
The specimen D is PP +20% Reogard2000®,
The specimen E is PP +25% Reogard2000®.

2. CONCLUSIONS

Fire tests and analyses the thermal behaviour of different samples led to the conclusion that the samples loaded with 20% and 15% are particularly comparable.
In fact, they also indicate a maximum speed limit of oxygen and the loss of weight for each of these samples are the same.

From the point of view of mechanical strength, the maximum rate which is included in polypropylene Reogard2000® without causing visible changes is equal to 20%.

This study concluded that 15% the threshold is Reogard2000® that integrates in polypropylene without causing visible changes.

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